IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

#8 AB 9/9/03

Applicant: Yu-Hsi Wang

Group Art Unit: 1746

Serial No.: 09/847,511

Examiner: Michail Kornakov

Filed: May 2, 2001

For: Wet Stripping Apparatus and Method of Using

Attorney Docket No.: 67,200-404

EXPRESS MAIL CERTIFICATE

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Kathy Dixon

APPEAL BRIEF

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Sir:

Appellants appeal in the captioned application from the Examiner's final rejection, dated April 4, 2003, of claims 1-20, under 35 USC §103(a) as being unpatentable over Komatsuzaki '945, Erk et al '505, Hand Book of Semiconductor Wafer Cleaning Technology, Cardani et al '999, Ward et al '186, Applicants' Admitted Prior Art and Noguchi '631.

It is urged that the rejection be reversed and that all the claims be allowed.

(1) REAL PARTY IN INTEREST

The real party in interest in the present appeal is the recorded Assignee of Taiwan Semiconductor Manufacturing Company, Ltd.

(2) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that are known to the Appellants, the Appellants' legal representative, or the assignee.

(3) STATUS OF CLAIMS

Claims 1-20 are pending in the application.

Claims 1-20 stand rejected.

(4) STATUS OF AMENDMENTS

A Request For Reconsideration was filed on or about June 4, 2003.

An Advisory Action was received from the Examiner dated June 20, 2003, maintaining rejection of all claims.

A Notice of Appeal was filed on or about June 27, 2003.

(5) SUMMARY OF THE INVENTION

The invention relates to a wet stripping apparatus capable of moving reciprocally in a stripper solution for removing thick photoresist layers from the wafer surface and a method for using the apparatus.

(Specification, paragraph 001)

In a preferred embodiment, a wet stripping apparatus for removing unwanted film layers from a wafer surface is provided which includes a tank body for holding a volume of a stripper solution therein; a wafer holder for holding at least one wafer therein in a vertical position such that a planar surface of the wafer is parallel to a vertical tank wall of the tank body; and means for reciprocally moving the wafer holder in an up-and-down motion with the at least one wafer immersed in the stripper solution at a frequency of not higher than 100 cycle/min.

(Specification, paragraph 0016)

The present invention is further directed to a method for removing unwanted film layers from a wafer surface by wet stripping which can be carried out by the operating steps of providing a tank body and filling the tank body with a volume of a stripper solution; providing a wafer holder for holding at least one wafer therein in a vertical position with a planar surface of the wafer

parallel to a vertical tank wall of the tank body; mounting the wafer holder in the tank body immersed in the stripper solution; and moving the wafer holder reciprocally in an up-and-down motion with the at least one wafer immersed in the stripper solution at a frequency of not more than 100 cycle/min.

(Specification, paragraph 0018)

(6) **ISSUES**

Issue I

Is the rejection of claims 1-2, 5-6, 9 and 15 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue II

Is the rejection of claim 14 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and Handbook of Semiconductor Wafer Cleaning Technology (The Book) proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue III

Is the rejection of claim 7 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and Cardani et al proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue IV

Is the rejection of claims 8 and 10-11 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and Ward et al proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue V

Is the rejection of claims 1-4 under 35 USC §103(a) as being unpatentable over Weber et al, Erk et al and the Appellants' Own Prior Art Disclosure proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue VI

Is the rejection of claims 12-13, 16-17 and 20 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and Noguchi proper when such references do not teach or suggest the specifically claimed limitations in the present application?

Issue VII

Is the rejection of claims 18 and 19 under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al, Noguchi and Appellants' Own Prior Art proper when such references do not teach or suggest the specifically claimed limitations in the present application?

(7) **GROUPING OF CLAIMS**

The rejection of claims 1-2, 5-6, 9 and 15 under 35 USC §103(a) are contested as a group.

The rejection of claim 14 under 35 USC §103(a) is contested as a separate group.

The rejection of claim 7 under 35 USC §103(a) is contested as a separate group.

The rejection of claims 8 and 10-11 under 35 USC §103(a) is contested as still another separate group.

The rejection of claims 1-4 under 35 USC §103(a) is contested as yet another separate group.

The rejection of claims 12-13, 16-17 and 20 under 35 USC §103(a) is contested as a separate group.

The rejection of claims 18 and 19 under 35 USC §103(a) is contested as a further separate group.

(8) **ARGUMENTS**

Issue I

Claims 1-2, 5-6, 9 and 15 are rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki '945 in view of Erk et al '505. It is contended that Komatsuzaki substantially teaches an apparatus and a method similar to that of the present invention and while Komatsuzaki fails to teach the frequency of an up and down motion, such is taught by Erk et al.

The rejection of claims 1-2, 5-6, 9 and 15 under 35 USC §103(a) based on Komatsuzaki and Erk et al is improper and must be reversed.

Komatsuzaki discloses an apparatus for chemical etching of a wafer including an apparatus containing means for moving wafers in an **up and down motion** immersed in an etch solution. However, the Applicants agree with the Examiner that Komatsuzaki does not teach the frequency of the up and down movement.

Erk et al discloses a method for cleaning semiconductor wafers with sonic energy and **passing through a gas-liquid-interface** wherein the surface of a wafer repeatedly passes through a gas-liquid-interface. As clearly shown by Erk et al in Figs. 2 and 3, and at col. 5, lines 52-63:

> "Operation of the motor 86 rotates the camming mechanism 62 about the axis X to simultaneously reciprocate and rotate the semiconductor wafers W. The reciprocation action causes the center C of each semiconductor wafer W to move up and down

> **between the upper level L_1** (Fig. 2)and the **lower level L_2** (Fig. 3). The **level 48 of cleaning liquid** in the bath 42 is selected to be generally **midway between the upper and lower levels L_1, L_2** ..."

Furthermore, at col. 6, lines 2-5, Erk et al stated:

> "As explained above, cleaning of the semiconductor wafers W in the sonic bath 42 is most effective **at or near the gas-liquid-interface 46**."

Erk et al therefore teaches a completely different cleaning method than that taught either by Komatsuzaki or the present invention. For instance, the present invention, as clearly recited in independent claims 1 and 9:

> "means for reciprocally moving said wafer holder in an up-and-down motion **with said at least one wafer immersed in said stripper solution** at a frequency of not more than 100 cycle/min."

The Appellants respectfully submit that since Erk et al teaches a cleaning method in which a wafer is only half immersed in liquid and ultrasonic waves are used at the gas-liquid-interface,

while Komatsuzaki teaches a method in which a wafer is **completely immersed** in a stripper solution, and cleaned by mechanical agitation in the cleaning solution. There can be no motivation to combine the teachings of Erk et al with that of Komatsuzaki. Komatsuzaki teaches a cleaning method in which a wafer is completely immersed in the etch solution without using ultrasonic energy. The Komatsuzaki reference therefore cannot be modified by the Erk et al reference in arriving at a §103(a) rejection since **there can be no motivation to combine two completely different methods** in arriving at the present invention.

The rejection of claims 1-2, 5-6, 9 and 15 under 35 USC §103(a) based on Komatsuzaki and Erk et al is improper and must be reversed.

Issue II

Claim 14 is rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and further in view of Handbook of Semiconductor Wafer Cleaning Technology (The Book). It is contended that while the combined teaching of Komatsuzaki and Erk et al fails to disclose spin drying of wafers after processing, such is disclosed by The Book.

Claim 14 depends on claim 9 which the Appellants have shown is not taught or disclosed by the two primary references of Komatsuzaki, Erk et al, either singularly or in combination thereof. The Appellants therefore respectfully submit that the additional reference of The Book does not lend any additional weight in a §103(a) rejection since the two primary references do not teach the basic process.

Issue III

Claim 7 is rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and further in view of Cardani et al '999. It is contended that while the combined disclosure of Komatsuzaki and Erk et al fails to teach the utilization of electrical heating means, such is disclosed by Cardani et al.

Analogous to the arguments presented above regarding claim 14, the Appellants respectfully submit that since the two primary references of Komatsuzaki and Erk et al do not teach the basic apparatus recited in claim 1, the additional reference of Cardani et al does not lend any additional weight in a §103(a) rejection.

Issue IV

Claims 8 and 10-11 are rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and further in view of Ward et al '186. It is contended that while the combined teaching of Komatsuzaki and Erk et al does not provide for the stripper solution that contains DMSO and TMAH, such are disclosed by Ward et al in an aqueous composition comprising DMSO and TMAH.

Claim 8 depends on independent claim 1, while claims 10 and 11 depend on independent method claim 9. The Appellants have clearly shown that independent claims 1 and 9 are not rendered obvious by the two primary references of Komatsuzaki and Erk et al, the Appellants respectfully submit that Ward et al does not teach the basic apparatus of claim 1, nor the basic process of claim 9.

The rejection of claims 8 and 10-11 under 35 USC §103(a) based on Komatsuzaki, Erk et al and Ward et al is improper and must be reversed.

Issue V

Claims 1-4 are rejected under 35 USC §103(a) as being unpatentable over Weber et al '431 in view of Erk et al '505 and further in view of Appellants' own prior art disclosure. It is

contended that Weber et al teaches a device for treating substrates including means for lifting and lowering or reciprocating vertically a wafer receiving device. While the teaching of Weber et al is silent on the frequency of the reciprocal motion, such is taught by Erk et al.

The rejection of claims 1-4 under 35 USC §103(a) based on Weber et al, Erk et al and Applicants' own prior art disclosure is improper and must be reversed.

Weber et al discloses a device for treating substrates in a fluid container wherein a nozzle system is connected to the sidewalls and/or bottom of the fluid container for introducing a fluid into the fluid container (see Abstract). As recited in col. 4, lines 6-11, lines 23-24:

> "By using nozzles for introducing the fluid it is also possible to introduce and allow the fluid **to flow with high inflowing velocity and high throughput velocity** per time unit into and within the fluid container so that, **by maintaining a laminar flow, extremely high flow velocities can be achieved.**"

"The nozzles are preferably arranged at the bottom of the fluid container and, ..."

Furthermore, at col. 8, lines 29-33:

"Thus, within the fluid container 1 only a minimal amount of additional space for the substrate receiving device is required so that **the fluid volume within the fluid container 1 can be maintained at a low level**."

Weber et al therefore does not teach a wet stripping apparatus wherein, as clearly recited in the present invention independent claim 1:

"... said at least one wafer immersed in said stripper solution ..."

In the Weber et al apparatus, a spray of a fluid from a plurality of nozzles is used to clean the wafers and the fluid container 1 is not filled with the fluid, let alone filled to completely immerse the wafers. The fact that the nozzles of Weber et al are arranged at the bottom of the fluid container indicates that it would have been impossible to spray the fluid onto the

wafers if the container is full of the fluid. The Appellants further submit that combining the teachings of Erk et al and the Appellants' own prior art disclosure does not disclose the apparatus of claim 1.

The rejection of claims 1-4 under 35 USC §103(a) based on Weber et al, Erk et al and Applicants' own prior art disclosure is improper and must be reversed.

Issue VI

Claims 12-13, 16-17 and 20 are rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al and further in view of Noguchi '631. It is contended that while the combined teaching of Komatsuzaki and Erk et al does not indicate the step of stationary soaking of the wafer in treatment solution, such is disclosed by Noguchi.

The Appellants have shown that the basic method claim 9, and similarly the basic method claim 16, which contain the process step of immersing the wafer in the stripper solution is not taught or disclosed by the primary references of Komatsuzaki and Erk et al. The additional reference of Noguchi does not lend any additional weight in a §103(a) rejection for claims 12-13, 16-17 and 20.

Issue VII

Claim 18 is rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al, Noguchi and further in view of Appellants' own prior art disclosure.

Claim 19 is rejected under 35 USC §103(a) as being unpatentable over Komatsuzaki, Erk et al, Noguchi and further in view of Handbook of Semiconductor Wafer Cleaning Technology (The Book).

The rejection of claims 18 and 19 under 35 USC §103(a) based on Komatsuzaki, Erk et al, Noguchi and Applicants' own prior art disclosure and The Book is improper and must be reversed.

The Appellants have shown that the two primary references of Komatsuzaki and Erk et al does not teach the base method claim 16 in which a wafer is immersed in a stripper solution and reciprocally moved at a frequency of not more than 100 cycle/min., the Appellants respectfully submit that the additional references of Noguchi, Appellants' own prior art disclosure and The Book do not lend any additional weight in a §103(a) rejection since, Komatsuzaki cannot be modified by Erk et al which teaches a completely different cleaning method of sonic cleaning at a gas-liquid-interface.

CLOSING

In summary, the Appellants have shown that their claimed invention is fully supported by a body of evidence of non-obviousness. It is therefore respectfully submitted that such evidence of non-obviousness overcomes any showing of obviousness presented by the Examiner. The Appellants therefore submit that the final rejection of their claims 1-20 is improper under 35 USC §103(a).

The reversal of the final rejection is respectfully solicited from the Board.

Respectfully submitted,

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CLAIM APPENDIX

1. A wet stripping apparatus for removing unwanted film layers from a wafer surface comprising:

a tank body for holding a volume of a stripper solution therein;

a wafer holder for holding at least one wafer therein in a vertical position such that a planar surface of the wafer is parallel to a vertical tank wall of said tank body; and

means for reciprocally moving said wafer holder in an up-and-down motion with said at least one wafer immersed in said stripper solution at a frequency of not more than 100 cycle/min.

2. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1 further comprising heating means in said tank body for heating said stripper solution.

3. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1, wherein said wafer holder is a front open unified pod (FOUP) for holding up to 25 wafers.

4. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1, wherein said wafer holder is a standard mechanical interface (SMIF) pod.

5. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1, wherein said means for reciprocally moving said wafer holder is an air cylinder assembly.

6. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1, wherein said means for reciprocally moving said wafer holder is an air cylinder assembly that moves at a frequency of about 60 cycle/min.

7. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 2, wherein said heating means is an electrical heating means.

8. A wet stripping apparatus for removing unwanted film layers from a wafer surface according to claim 1, wherein said stripper solution comprises dimethyl sulfoxide (DMSO).

9. A method for removing unwanted film layers from a wafer surface by wet stripping comprising the steps of:

providing a tank body and filling the tank body with a volume of a stripper solution;

providing a wafer holder holding at least one wafer therein in a vertical position with a planar surface of the wafer parallel to a vertical tank wall of said tank body;

mounting said wafer holder in said tank body immersed in said stripper solution; and

moving said wafer holder reciprocally in an up-and-down motion with said at least one wafer immersed in said stripper solution at a frequency of not more than 100 cycle/min.

10. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the step of filling the tank body with a stripper solution that comprises dimethyl sulfoxide (DMSO).

11. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the step of filling the tank body with a stripper solution that comprises dimethyl sulfoxide (DMSO) and tetramethyl ammoniumhydroxide (TMAH).

12. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the step of mounting said wafer holder in said tank body and soaking said at least one wafer in said stripper solution stationarily for at least 3 min.

13. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the step of mounting said wafer holder in said tank body and soaking said at least one wafer in said stripper solution stationarily for at least 3 min and then moving said wafer holder up-and-down at a frequency of not more than 100 cycle/min.

14. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the steps of:

rinsing said wafer holder and said at least one wafer in a quick dump rinse (QDR) process; and

spin drying said at least one wafer.

15. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 9 further comprising the step of moving said wafer holder reciprocally in an up-and-down motion for a length of time sufficient to remove all unwanted film layers from said wafer surface.

16. A method for removing unwanted film layers from a wafer surface by wet stripping comprising the steps of:

providing a tank body and filling the tank body with a volume of a stripper solution;

providing a wafer holder holding at least one wafer therein in a vertical position with a planar surface of the wafer parallel to a vertical tank wall of said tank body;

mounting said wafer holder in said tank body and immersing said at least one wafer stationarily in said stripper solution for a time period of at least 3 min; and

moving said wafer holder reciprocally in an up-and-down motion with said at least one wafer immersed in said stripper solution at a frequency of not more than 100 cycle/min.

17. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 16 further comprising the step after said moving step of immersing said at least one wafer stationarily in said tank body for a time period of at least 10 sec.

18. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 16 further comprising the step of filling the tank body with a stripper solution that comprises dimethyl sulfoxide (DMSO).

19. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 16 further comprising the steps of:

rinsing said wafer holder and said at least one wafer in a quick dump rinse (QDR) process; and

spin drying said at least one wafer.

20. A method for removing unwanted film layers from a wafer surface by wet stripping according to claim 16 further comprising the step of moving said wafer holder reciprocally in an up-and-down motion for a length of time sufficient to remove all unwanted film layers from said wafer surface.